Voluntary
Nonpoint Source Pollution
Implementation Strategies

for

Cuivre River and North Fork Cuivre River
Total Maximum Daily Load
Pike and St. Charles Counties

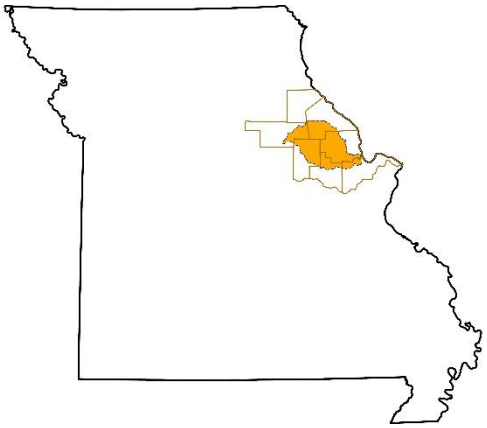
Pollutant: *Escherichia coli*

Updated: September 12, 2023

WATER BODY SUMMARY

Names: Cuivre River, North Fork Cuivre River

Location: Pike and St. Charles Counties



Location of watershed in Missouri

8-digit Hydrologic Unit Code (HUC):[1]
07110008– Cuivre River

12-digit HUC Subwatershed
See Section 2

Water Body Identification Number (WBID) and Hydrologic Class:[2]
WBID 152 – Class P – Cuivre River
WBID 158 – Class P – North Fork Cuivre River

Designated Uses:[3]
Irrigation
Livestock and wildlife protection
Human health protection
Warm water habitat (aquatic life)
Whole body contact recreation category A
Secondary contact recreation

Impaired Use:
Whole body contact recreation categories A

Pollutants Addressed through TMDLs:
Escherichia coli (E. coli) (fecal indicator bacteria)

Length and Location of Impaired Segments:
Cuivre River (WBID 152): 30 miles, from Sur 1795, Township 48N, Rage 2E to Section 14, Township 49N, Range 1W
North Fork Cuivre River (WBID 158): 25.1 miles, from mouth to Section 24, Township 51N, Range 3W

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[1] Watersheds are delineated by the U.S. Geological Survey using a nationwide system based on surface hydrologic features. This system divides the country into 2,270 8-digit hydrologic units (USGS 2019). A hydrologic unit is a drainage area delineated to nest in a multilevel, hierarchical drainage system. A hydrologic unit code is the numerical identifier of a specific hydrologic unit consisting of a 2-digit sequence for each specific level within the delineation hierarchy (FGDC 2003).

[2] For hydrologic classes see 10 CSR 20-7.031(1)(E). Class P streams maintain permanent flow even in drought periods.

[3] For designated uses see 10 CSR 20-7.031(1)(F) and 10 CSR 20-7.031 Table H. Presumed uses are assigned per 10 CSR 20-7.031(2)(A) and (B) and are reflected in the Missouri Use Designation Dataset described at 10 CSR 20-7.031(2)(E).

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1. Introduction

This implementation strategies document is a companion to the total maximum daily load (TMDL) report for Cuivre River and North Fork Cuivre River, which addresses elevated *Escherichia coli* (*E. coli*) bacteria concentrations that resulted in the water bodies' placement on Missouri's 2022 Section 303(d) List of Impaired Waters. This implementation strategies document suggests actions that will reduce pollutant loading from nonpoint sources in order to meet the water quality goals established in the TMDL report. The TMDLs established for the impaired water bodies represent the *E. coli* loading capacity for each stream, which is the maximum amount of a pollutant that a water body can assimilate and still attain and maintain water quality standards. The goal of the TMDLs are to attain and maintain recreational uses in the water bodies. Additional watershed characteristics and *E. coli* loading targets can be found in the TMDL report, which is available on the Missouri Department of Natural Resources' website at https://dnr.mo.gov/water/what-were-doing/water-planning/quality-standards-impaired-waters-total-maximum-daily-loads/tmdls. Although this implementation document is drafted primarily to implement the goals of the *E.coli* TMDL. Questions regarding the TMDLs may be sent via email to tmdl@dnr.mo.gov or by calling the Department's Watershed Protection Section at 573-751-5723.

This supplemental implementation document also provides information regarding nutrient loading. None of the water bodies addressed by the TMDL are currently identified as impaired for nutrients. This information is included because many of the suggested practices to reduce *E. coli* loading will also reduce nutrient loading. This information is provided for informational purposes only to guide watershed management planning activities and the implementation of best management practices (BMPs).

This document neither prescribes nor prohibits any specific practices or technologies for reducing pollutant loading in the impaired water bodies and is not intended to serve as a comprehensive plan or the sole means of remediation and restoration. The Department recognizes that technical guidance and support are critical to achieving the goals of any TMDL. Therefore, while the TMDL calculates the maximum pollutant loading that the impaired stream can assimilate and still attain and maintain water quality standards, this strategies document provides additional information to assist in meeting the TMDL loading goals including: pollutant reduction strategies, example calculations of pollutant reductions, potential participants in the watershed, and funding sources. The TMDL addresses pollutant loading from all potential sources in the watershed, however, this strategies document is primarily intended to provide guidance for meeting nonpoint source loading targets.[4] The Department addresses point source pollutant reductions through the Missouri State Operating Permit program.[5]

Watershed management practices that reduce nonpoint source pollutant loading are conducted voluntarily by interested groups and landowners within the watersheds. In accordance with Section 319 of the federal Clean Water Act, the U.S. Environmental Protection Agency (EPA) provides funding for nonpoint source pollutant load reduction practices. Section 319 nonpoint source subgrants are administered by the Department through Missouri's Section 319 program to assist

[4] Point and nonpoint sources are defined and discussed in Sections 5.1 and 5.2 of the TMDL report for Cuivre River and North Fork Cuivre River.

[5] The Missouri State Operating system is Missouri's program for administering the federal National Pollutant Discharge Elimination System (NPDES) program. The NPDES program requires all point sources that discharge pollutants to waters of the United States to obtain a permit. Issued and proposed operating permits are available online at https://dnr.mo.gov/water/business-industry-other-entities/permits-certification-engineering-fees.

organizations with watershed planning or implementation of activities as described in an accepted nine element watershed management plan (or alternative plan under certain specific conditions). The Nine Key Elements of a Watershed Management Plan are provided in Appendix A. More information on Missouri's Section 319 subgrant program is available at: dnr.mo.gov/water/what-were-doing/nonpoint-source-pollution-section-319. Potential government support and sources of funding are provided in Section 10 of this document.

2. Watershed Characteristics

Cuivre River and North Fork Cuivre River are located north of St. Louis within the Cuivre River subbasin, which is cataloged by the U.S. Geological Survey (USGS) as the 8-digit hydrologic unit code (HUC) 07110008. The Cuivre River subbasin is composed of 34 individual, 12-digit HUC, subwatersheds totaling 1,261 square miles (Table 1). The North Fork Cuivre River (WBID 158) originates at the eastern border of Lincoln County and flows south for 25 miles where it merges with the West Fork Cuivre River and becomes the Cuivre River (WBID 152). The Cuivre River flows southeast for 42 miles and flows into the Mississippi. The impaired segment of the Cuivre River is the northwest, 30 mile-upstream. The size of the impaired segment of the watershed is 1,231 square miles (Figure 1). Within the watershed is the North Fork Cuivre River watershed which is 337 square miles.

Within the Cuivre River subbasin, four water bodies are listed as impaired and one water body has a previously developed TMDL. The four impaired water bodies are the Cuivre River (WBID 152), the North Fork Cuivre River (WBID 158), Vandalia Lake (WBID 7051), and Elkhorn Creek (WBID 189). As previously stated, this Implementation Strategies document will address the Cuivre River and the North Fork Cuivre River *E. coli* impairments. Vandalia Lake's aquatic life use is impaired by Chlorophyll a and will be addressed in a future TMDL. Elkhorn Creek's aquatic life use is impaired by low dissolved oxygen. In 2006, EPA approved a permit in lieu of a TMDL for Montgomery City NE Wastewater Treatment Plant to address biological oxygen demand, total suspended solids, and ammonia in Elkhorn Creek. The segment above the treatment plant is still listed as impaired and was last monitored in 2018. A TMDL was approved, on July 14, 2008, for Mill Creek (WBID 159) to address sediment. At the time of this document, Mill Creek is attaining water quality standards. These other approved or established TMDLs are available on the Department's website at dnr.mo.gov/water/what-were-doing/water-planning/quality-standards-impaired-waters-total-maximum-daily-loads/tmdls.

Table 1. 12-digit HUC subwatersheds in Cuivre River Watershed

12-digit HUCs	Subwatershed Name
071100080101	Headwaters West Fork Cuivre River
071100080102	Hickory Creek
071100080103	Johns Branch-West Fork Cuivre River
071100080104	Coon Creek
071100080105	Sandy Fork-West Fork Cuivre River
071100080201	Headwaters Indian Creek
071100080202	Cuivre Creek
071100080203	Indian Creek
071100080204	Lick Creek-North Fork Cuivre River
071100080205	Sandy Creek

12-digit HUCs	Subwatershed Name
071100080206	Sulphur Creek
071100080207	Mill Creek-North Fork Cuivre River
071100080208	North Fork Cuivre River
071100080301	Upper Elkhorn Creek
071100080302	Middle Elkhorn Creek
071100080303	Lower Elkhorn Creek
071100080304	Brush Creek
071100080305	Little Bear Creek-Bear Creek
071100080306	Bear Creek
071100080307	Camp Creek
071100080308	Bracht Branch-West Fork Cuivre River
071100080309	Lead Creek
071100080310	West Fork Cuivre River
071100080401	Sugar Creek
071100080402	Crooked Creek
071100080403	Spring Creek-Cuivre River
071100080404	Upper Big Creek
071100080405	Coon Creek
071100080406	Middle Big Creek
071100080407	Indian Camp Creek
071100080408	McCoy Creek
071100080409	Lower Big Creek
071100080410	Groshong Branch-Cuivre River
071100080411	Cuivre River

The Cuivre River and North Fork Cuivre River are located within the Cuivre/Salt ecological drainage unit (MoRAP 2005). Within the Cuivre/Salt ecological drainage unit, the eastern half of the Cuivre River watershed is within the River Hills EPA Level IV ecoregion and the western half within the Claypan Prairie ecoregion. Roughly 70 percent of the North Fork Cuivre River is within the River Hills Ecoregion and the northern thirty percent of the watershed is in the Claypan Prairie ecoregion. The Claypan Prairie region is nearly flat, except for the steep sections near streams. The western section within the River Hills is hillier and steeper than the Claypan Prairie (MoRAP 2005).

Land cover types present in the Lost Creek watersheds are shown in Table 2. Figure 2 depicts the distribution of the land cover types throughout the watershed. Grassland and pastures areas potentially used for livestock grazing cover 65 percent of the Cuivre River and North Fork Cuivre River watersheds.

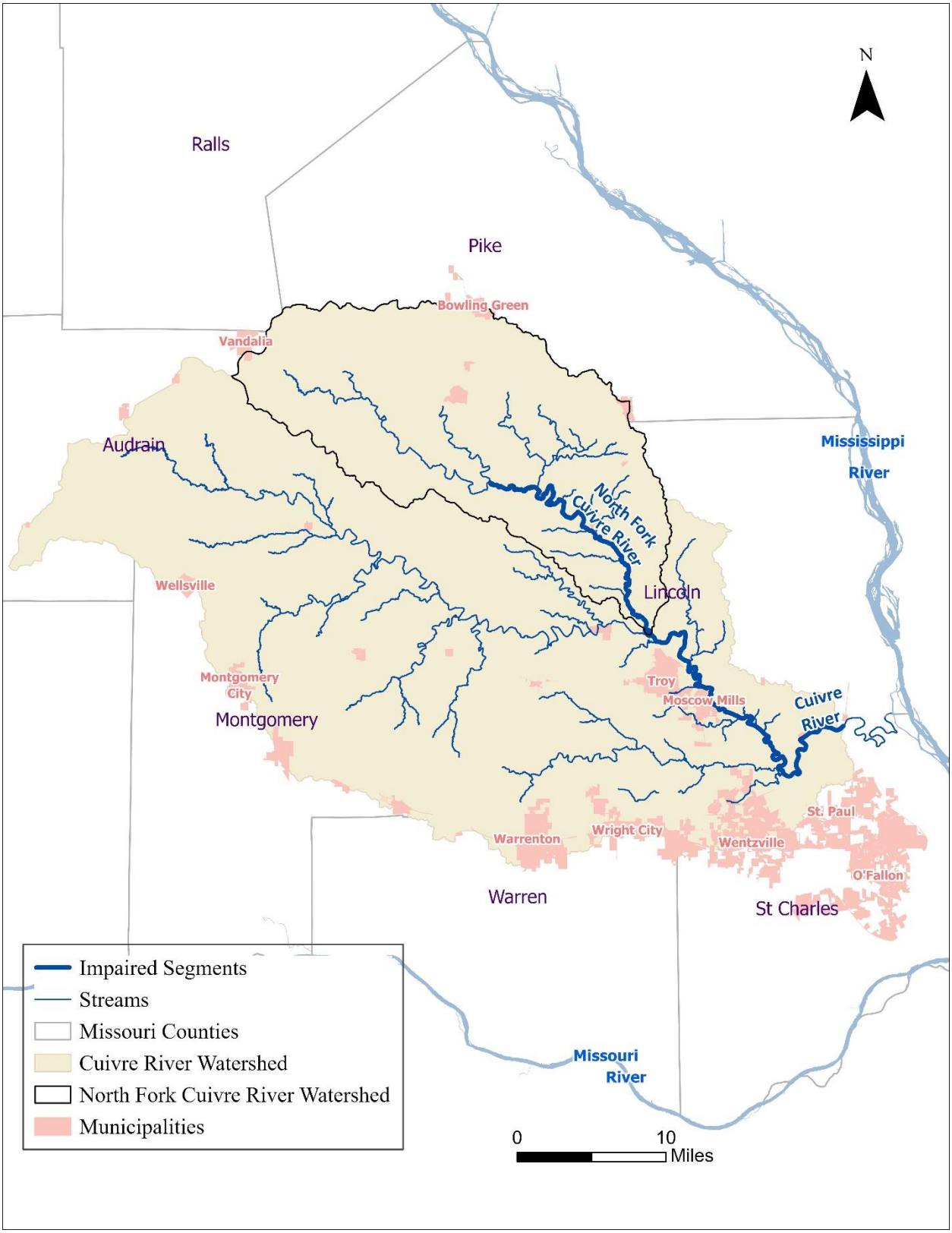

Figure 1. Location of the Cuivre River and North Fork Cuivre River Watersheds

Table 2. Land Cover in the Cuivre River Watershed

Hydrologic Soil Group	Area in the Watershed	
	Square Miles	Percent
Cuivre River		
B	44.08	3.58%
B/D	21.15	1.72%
C	261.36	21.21%
C/D	260.32	21.12%
D	633.53	51.41%
Not Rated	11.96	0.97%
Total	1,231.40	100.00%
North Fork Cuivre River		
B	9.45	2.80%
B/D	3.34	0.99%
C	93.82	27.82%
C/D	117.65	34.88%
D	111.74	33.13%
Not Rated	1.28	0.38%
Total	337.28	100.00%

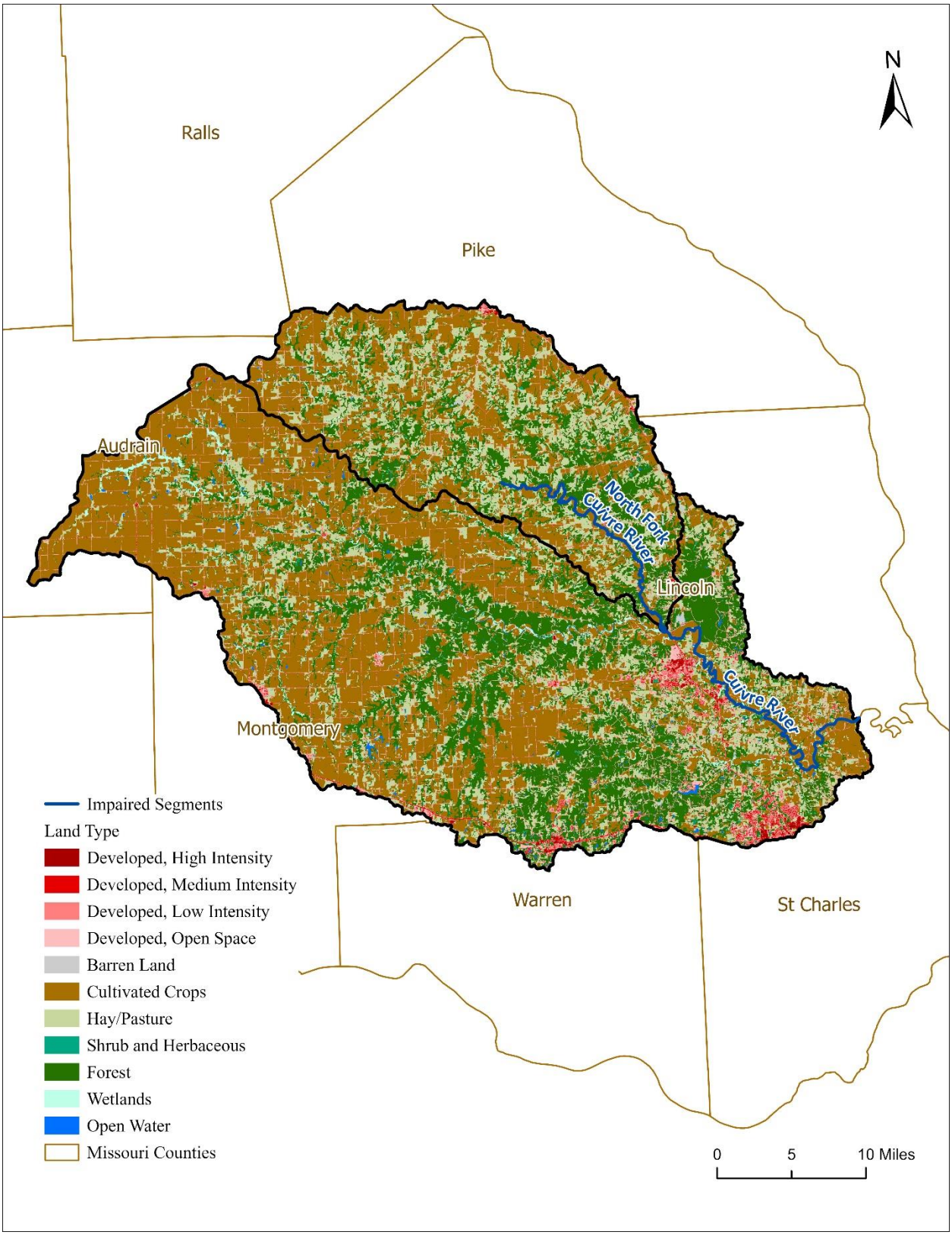

Figure 2. Land Cover in the Cuivre River Watershed

3. Water Quality Impairments

Water quality criteria represent a level of water quality that supports and protects designated uses. Specific numeric *E. coli* bacteria criteria are given in Missouri's Water Quality Standards at 10 CSR 20-7.031(5)(F) and Table A1. *E. coli* are bacteria found in the intestines of humans and warm-blooded animals and are used as indicators of potential fecal contamination and risk of pathogen-induced illness to humans. The *E. coli* criterion for the whole body contact recreation category A (WBC-A) designated use is 126 colony forming units (cfu) per 100 milliliters (mL).

Whole body contact recreation includes activities that involve direct human contact with waters of the state to the point of complete body submergence (10 CFR 20-7.031(1)(C)2.A.). During such activities, such as swimming, accidental ingestion of the water may occur and there is direct contact to sensitive body organs, such as the eyes, ears, and nose. Whole body contact category A applies to waters that have been established by the property owner as public swimming areas welcoming access by the public for swimming purposes and waters with documented existing whole body contact recreation uses by the public (10 CSR 20-7.031(1)(F)2.A.(I)). Secondary contact recreation, which includes activities such as boating, fishing, and wading, are activities that may result in contact with the water that is either incidental or accidental and the probability of ingesting appreciable quantities of water is minimal (10 CSR 20-7.031(1)(F)2.B.). The Department determines that a stream is impaired for *E. coli* bacteria when the water quality criteria are exceeded in any of the last three years for which there is a minimum of five samples collected during the recreational season. This approach is detailed in the Department's 2022 Listing Methodology Document, which is available online at dnr.mo.gov/water/what-were-doing/water-planning/quality-standards-impaired-waters-total-maximum-daily-loads/tmdls.

In accordance with Missouri's 2022 Listing Methodology Document, the whole body contact recreation category A designated use for Cuivre River and North Fork Cuivre River are impaired. Sufficient data consistent with the assessment methodology are available to support these listings as summarized in Table 3. As shown, Cuivre River *E. coli* concentrations exceeded the criterion in 2017 and North Fork Cuivre River in 2013-2022. A summary of recreational season *E. coli* data used to assess water quality in the Cuivre River and North Fork Cuivre River are displayed in Table 3 and Figure 3.

Recent data indicates that West Fork Cuivre River (WBID177), a tributary of the Cuivre River, has high *E.coli* concentrations. In 2021, it was monitored for *E. coli* 19 times within the recreational season and had a geometric mean of 259.2 which exceeds the criterion for WBC-A. In 2022, it was monitored for *E. coli* twice and had a concentration of 4,839. Although more data and analysis is needed to determine whether or not the use is impaired, the data indicates that the West Fork Cuivre River has high concentrations of *E. coli* and should be considered when developing watershed plans. Monitoring data for Cuivre River, West Fork Cuivre River, and North Fork Cuivre River can be found in Appendix C.

Table 3. Summary of Recreational Season *E. coli* Data for the Impaired Water Bodies*

Water Body	Recreational Season	Number of Samples	Min (cfu/100 mL)	Max (cfu/100 mL)	Geometric Mean (cfu/100 mL)
Cuivre River	2017	9	13	4,839	282
	2018	9	14	4,839	83
	2019	5	5	120	35
	2020	2	16	210	Insufficient Data
North Fork Cuivre River	2013	13	20	4,839	190
	2014	14	71	1,986	379
	2015	7	272	4,839	662
	2016	3	579	4,839	Insufficient Data
	2021	15	34	4,839	340
	2022	3	4,839	4,839	Insufficient Data

* For water quality assessment purposes, geometric means are calculated only for years having a minimum of five samples

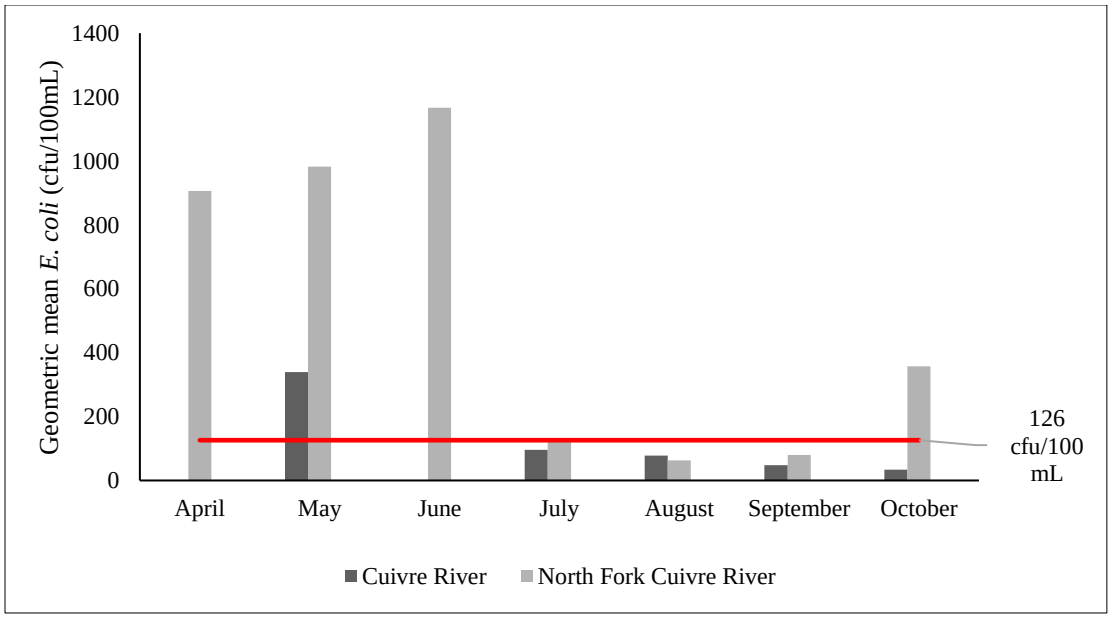

Figure 3. Geometric Means of *E. coli* Data by Month (Includes years with <5 samples and includes data form 2010 to 2022).

4. Causes and Sources of Pollutant Loads

Section 5 of the Cuivre River *E. coli* TMDL provides an inventory and assessment of all known and suspected sources of bacteria loading in those watersheds. The bacteria sources identified in the TMDL document are based on issued permits and a general knowledge of watershed conditions. TMDLs often lack data to identify specific *E. coli* contributions from specific nonpoint sources. Even so, all sources identified have the potential to contribute bacteria loading to surface waters and best management practices (BMPs) to reduce loading from those sources will provide overall water quality benefits to the impaired streams.

4.1 Agricultural Stormwater Runoff

Croplands, pasturelands, and low-density animal feeding operations are potential sources of bacteria in surface waters. Bacteria are transported in runoff from areas fertilized with animal manure and where livestock are present. Runoff can result from precipitation or excessive irrigation. Section 640.760 Revised Statutes of Missouri (RSMo) establishes setback distances for surface application of liquefied manure from a Concentrated Animal Feeding Operation (CAFO) by a third party.[6] Pursuant to Section 640.760 RSMo, the Department may enforce stricter setbacks. Soil and Water Conservation Districts provide funding and guidance for the development of nutrient management plans for private lands. Areas where nutrient management plans guide manure application and where BMPs are used to reduce soil erosion contribute less bacteria to surface waters than unmanaged areas. Although grazing areas are typically well vegetated, livestock tend to congregate near feeding and watering areas and create barren areas that are susceptible to erosion (Sutton 1990). Livestock that are not excluded from streams deposit manure and thus bacteria directly into waterways. Although agricultural stormwater runoff is a potential contributor of *E. coli* loading, individual land management practices and use of BMPs varies throughout the watershed. Areas where BMPs and nutrient management plans are employed are expected to contribute less *E. coli* than unmanaged areas.

4.2 Urban Stormwater Runoff

Developed areas where stormwater discharges are not regulated through municipal separate storm sewer permits are nonpoint sources of *E. coli* loading. Birds, dogs, cats, and rodents are documented as common sources of *E. coli* in urban stormwater (Burton and Pitt 2002). Irrigation runoff from residential lawns where pet wastes are present may also contribute *E. coli* loads to surface waters. A review of available aerial imagery does show areas of residential housing upstream of where high concentrations of bacteria loading have been observed. For this reason, unregulated stormwater runoff from these developed areas is a potential source of *E. coli* loading to the impaired water bodies. Residential land owners and municipalities not currently regulated by MS4 permits should consider best management practices and low impact development to mitigate potential pollutant loading.

4.3. Onsite Wastewater Treatment Systems

The Missouri Department of Health and Senior Services or a local onsite wastewater authority, typically the county health department, has jurisdictional authority for domestic wastewater treatment systems when the maximum daily flows of domestic wastewater is less than or equal to 3,000 gallons per day, for individual systems with subsurface soil dispersal serving a single family residence, and individual lagoons that serve no more than a single family residence.

Properly functioning onsite residential wastewater treatment systems should not contribute significant amounts of *E. coli* to surface waters. Traditional septic systems are generally composed of several parts: tank(s) to contain liquid and allow settling of solids, a drainage (adsorption) field where liquid wastewater infiltrates the ground, and a filter to keep solids from entering the drainage field. All three of these parts must be in good order for a septic system to function properly. The removal of bacteria occurs mainly in the adsorption field by filtration and mortality. Failing systems, however, may be sources of bacteria during wet or dry weather. Factors that may make septic

[6] Section 640.760 RSMo setback distances are: 50 feet from a property boundary, 300 feet from any public drinking water lake, 300 feet from any public drinking water intake structure, 100 feet from any perennial and intermittent streams without vegetation abutting such streams, and 35 feet from any perennial and intermittent streams with vegetation abutting such streams.

systems ineffective include age, inadequate land area, poor soil for drainage, high water table, and inadequate maintenance. Proper maintenance of onsite residential wastewater treatment systems including septic tanks, associated drain fields, and household lagoons should minimize bacteria loading to surface waters. Although not addressed by a TMDL, it should be noted that failing onsite wastewater treatment systems may also be sources of excess nutrients in surface waters, which can be addressed using the same BMPs that address *E.coli*. Additional resources and EPA guide to septic systems may be found at https://www.epa.gov/septic.

4.4 Riparian Corridor Conditions

Riparian corridor conditions have a strong influence on instream water quality. Wooded riparian buffers are a vital functional component of stream ecosystems and are instrumental in the attenuation of pollutants in runoff. Land cover within 100 feet of streams in the watershed is presented in Table 4 and Table 5. Riparian areas directly adjacent to agricultural or urban areas may be more susceptible to direct *E. coli* loading. Over 54 percent of the riparian corridors in the Cuivre River watershed are forested and around 59 percent of the riparian corridors in North Fork Cuivre River watershed are forested. This indicates that some *E. coli* transported from adjacent lands may be intercepted before it enters the streams.

Table 4. Land Cover in Riparian Corridors in the Cuivre River Watershed

Land Cover Type	Area Square Miles	Percent
Developed, High Intensity	0.05	0.07%
Developed, Medium Intensity	0.27	0.34%
Developed, Low Intensity	0.92	1.15%
Developed, Open Space	1.52	1.91%
Barren Land	0.13	0.16%
Cultivated Crops	12.76	16.01%
Hay/Pasture	10.23	12.84%
Shrub and Herbaceous	0.47	0.59%
Forest	43.44	54.51%
Wetlands	8.10	10.17%
Open Water	1.80	2.26%
Total	**79.70**	**100.00%**

Table 5. Land Cover in Riparian Corridors in the North Fork Cuivre River Watershed

Land Cover Type	Square Miles	Percent
Developed, High Intensity	0.01	0.03%
Developed, Medium Intensity	0.06	0.25%
Developed, Low Intensity	0.22	0.92%
Developed, Open Space	0.37	1.55%
Barren Land	0.02	0.10%
Cultivated Crops	3.11	12.99%

Hay/Pasture	4.09	17.07%
Shrub and Herbaceous	0.12	0.52%
Forest	14.07	58.71%
Wetlands	1.75	7.32%
Open Water	0.13	0.55%
Total	**23.97**	**100.00%**

5. Existing Loads and Needed Reductions

TMDL targets are based on the applicable *E. coli* criteria for the protection of recreational uses in each stream. These targets are represented in Section 7 of the TMDL using load duration curves. Observed data are plotted on the load duration curve graphs to demonstrate the magnitude of existing loading and can be used to estimate the amount of pollutant reduction needed to meet the target and attain water quality standards. Points above the curve exceed the loading capacity and points on or below the curve are in compliance with water quality standards. The load duration curves also help to identify and differentiate between storm-driven loading and the presence of continuous loading. Storm-driven loading is expected under wet conditions when precipitation and runoff are high. Continuous loading is often evident at low flows when point source discharges have greater influence on water quality. When no point sources are present, low flow exceedances may be due to onsite wastewater treatment systems or livestock entering the stream. In the Cuivre River and North Fork Cuivre River, bacteria reductions are needed during moist and high flow conditions, therefore BMPs that address stormwater runoff will address the most significant sources of pollutant loading to the river. Additional water quality monitoring conducted during watershed planning may help determine specific areas, or "hot spots," where significant loading is occurring and where BMPs may be the most effective. Groups wishing to develop a monitoring component to any localized watershed-based plan are encouraged to consult with the Department's Water Quality Monitoring and Assessment Unit, available at 573-522-4505.

5.1 *E. coli* Bacteria

The *E. coli* TMDLs for Cuivre River and North Fork Cuivre River are represented by load duration curves that quantify the loading capacities of each water body at all possible flows. Tables 6 and 7 summarize the TMDLs at selected flows and the load reductions that are needed to meet the TMDLs. The load reductions were calculated based on the geometric mean of observed *E. coli* data recorded during each selected flow regime. As shown, in both the Cuivre River and North Fork Cuivre River *E. coli* concentrations do not exceed water quality criterion during low flow and dry conditions.

Table 6. Cuivre River TMDLs and Needed Reductions

Time Flow is Exceeded	Flow Condition	Flow (cfs)	TMDL (cfu/day)	Existing Load (cfu/day)	Needed Reduction (cfu/day)	Needed Reduction (%)	Existing Concentration (cfu/100mL)
95%	Low Flow	31.29	9.64E+10	9.34E+09	0.00E+00	0.00%	12
75%	Dry Conditions	66.14	2.04E+11	5.64E+10	0.00E+00	0.00%	35
50%	Mid Range	190.39	5.87E+11	6.00E+11	1.35E+10	2.26%	129
25%	Moist Conditions	616.92	1.90E+12	4.59E+12	2.69E+12	58.61%	304
5%	High Flow	4,672.88	1.44E+13	1.28E+14	1.14E+14	88.77%	1,122

Table 7. North Fork Cuivre River TMDLs and Needed Reductions

Time Flow is Exceeded	Flow Condition	Flow (cfs)	TMDL (cfu/day)	Existing Load (cfu/day)	Need Reduction (cfu/day)	Needed Reduction (%)	Existing Concentration (cfu/100mL)
95%	Low flow	1.77	5.46E+09	8.63E+08	0.00E+00	0.00%	20
75%	Dry conditions	11.31	3.49E+10	1.94E+10	0.00E+00	0.00%	70
50%	Mid Range	45.33	1.40E+11	4.89E+11	3.50E+11	71.45%	441
25%	Moist Conditions	162.09	5.00E+11	2.74E+12	2.24E+12	81.74%	690
5%	High Flow	1,272.46	3.92E+12	1.46E+14	1.42E+14	97.31%	4,678

6. Implementation

Pollutant reductions from nonpoint sources to improve water quality are dependent upon voluntary actions and support from local communities and landowners in the watershed. The strategies described in this document are intended as guidance to local governments, regional planning commissions, private landowners, and citizen groups for achieving the load allocation targets established in the TMDL. This guidance does not establish any new legal requirements or costs upon any landowner for controlling nonpoint sources.

6.1 Nonpoint Source Management Activities Previously Implemented

The Missouri Soil and Water Conservation Program provides cost-share for a variety of BMPs that support reductions of *E. coli* loading from agricultural lands. Many soil and water conservation management practices that reduce erosion also reduce *E. coli* and nutrient loading. Table 8 summarizes the types of practices implemented in the Cuivre River and North Fork Cuivre River between 2016 and 2022. For more information on the different practice types see Appendix D.

Table 8. Soil and Water Conservation Practices in the Cuivre River Watershed*

HUC12	Practice Type	Number of Practices	Area of Implemented Practice (acres)
071100080101	Cover Crop	25	2,056
	Field Border	2	167
	Permanent Vegetative Cover Establishment	1	11
	Sediment Retention, Erosion, or Water Control Structure	7	250
	Sod Waterway	10	525
	Terrace System	2	26
	Terrace System with Tile	6	70
	Total	**53**	**3,105**
071100080102	Cover Crop	10	358
	Diversion	1	14
	Sediment Retention, Erosion, or Water Control Structure	3	94
	Sod Waterway	3	179
	Terrace System with Tile	6	86
	Total	**23**	**731**
071100080103	Cover Crop	22	1,975

HUC12	Practice Type	Number of Practices	Area of Implemented Practice (acres)
	Sediment Retention, Erosion, or Water Control Structure	2	49
	Sod Waterway	10	407
	Terrace System	3	38
	Terrace System with Tile	8	76
	Total	**45**	**2,544**
071100080104	Cover Crop	41	3,202
	Diversion	1	8
	Field Border	2	538
	Grazing System Water Development	1	16
	Nutrient Management	3	441
	Permanent Vegetative Cover - Critical Area	1	0
	Sod Waterway	12	531
	Terrace System with Tile	9	118
	Well Decommissioning	1	0
	Total	**71**	**4,854**
071100080105	Cover Crop	22	1,592
	Grazing System Water Distribution	1	61
	Permanent Vegetative Cover Establishment	3	108
	Pest Management	2	155
	Sediment Retention, Erosion, or Water Control Structure	3	60
	Sod Waterway	8	476
	Terrace System	3	51
	Terrace System with Tile	11	147
	Total	**53**	**2,650**
071100080201	Cover Crop	12	765
	Permanent Vegetative Cover Establishment	1	49
	Sediment Retention, Erosion, or Water Control Structure	2	46
	Sod Waterway	5	127
	Terrace System	1	7
	Terrace System with Tile	4	75
	Total	**25**	**1,069**
071100080202	Cover Crop	14	1,818
	Sod Waterway	5	136
	Terrace System with Tile	1	18
	Total	**20**	**1,972**
071100080203	Cover Crop	10	522
	Grazing System Seed	1	123
	Permanent Vegetative Cover Establishment	1	24
	Pest Management	2	140
	Sediment Retention, Erosion, or Water Control Structure	1	12
	Sod Waterway	2	2
	Terrace System	1	47

HUC12	Practice Type	Number of Practices	Area of Implemented Practice (acres)
	Terrace System with Tile	4	53
	Total	**22**	**922**
071100080204	Cover Crop	9	561
	Terrace System with Tile	1	16
	Total	**10**	**578**
071100080205	Cover Crop	13	1,651
	Total	**13**	**1,651**
071100080206	Cover Crop	14	627
	Sod Waterway	2	27
	Terrace System with Tile	5	101
	Water Impoundment Reservoir	1	15
	Total	**22**	**770**
071100080207	Cover Crop	18	1,424
	Sediment Retention, Erosion, or Water Control Structure	1	19
	Sod Waterway	1	31
	Total	**20**	**1,473**
071100080208	Cover Crop	34	2,174
	Sod Waterway	1	14
	Stream Protection	1	1
	Total	**36**	**2,189**
071100080301	Cover Crop	21	1,970
	Sediment Retention, Erosion, or Water Control Structure	1	49
	Sod Waterway	1	44
	Terrace System with Tile	4	68
	Water Impoundment Reservoir	1	39
	Total	**28**	**2,169**
071100080302	Cover Crop	43	3,731
	Diversion	1	14
	Permanent Vegetative Cover Establishment	1	19
	Sod Waterway	4	141
	Terrace System	2	20
	Terrace System with Tile	6	43
	Water Impoundment Reservoir	1	25
	Well Decommissioning	2	0
	Total	**60**	**3,993**
071100080303	Cover Crop	43	3,601
	Pest Management	1	115
	Terrace System with Tile	4	41
	Total	**48**	**3,757**
071100080304	Cover Crop	22	1,729
	Pest Management	1	18
	Sod Waterway	1	18
	Terrace System	1	23

HUC12	Practice Type	Number of Practices	Area of Implemented Practice (acres)
	Terrace System with Tile	2	34
	Total	**27**	**1,822**
071100080305	Cover Crop	59	3,395
	Grazing System Fence	1	111
	Grazing System Lime	2	77
	Grazing System Water Development	1	170
	Grazing System Water Distribution	1	183
	Permanent Vegetative Cover Establishment	2	110
	Pest Management	17	791
	Sod Waterway	5	115
	Terrace System with Tile	8	78
	Well Decommissioning	1	0
	Total	**97**	**5,027**
071100080306	Cover Crop	11	941
	Nutrient Management	1	79
	Pest Management	7	226
	Sod Waterway	1	0
	Terrace System with Tile	4	26
	Total	**24**	**1,272**
071100080307	Cover Crop	73	4,041
	Grazing System Lime	1	100
	Nutrient Management	1	73
	Permanent Vegetative Cover Establishment	1	30
	Pest Management	9	882
	Sod Waterway	4	110
	Terrace System with Tile	4	66
	Well Decommissioning	1	0
	Total	**94**	**5,302**
071100080308	Cover Crop	30	2,174
	Nutrient Management	1	61
	Pest Management	1	58
	Terrace System with Tile	1	19
	Total	**33**	**2,311**
071100080309	Cover Crop	52	4,114
	Permanent Vegetative Cover Establishment	1	29
	Sod Waterway	2	92
	Total	**55**	**4,235**
071100080310	Cover Crop	22	1,168
	Total	**22**	**1,168**
071100080401	Cover Crop	9	675
	Terrace System with Tile	1	21
	Total	**10**	**696**
071100080402	Cover Crop	8	462
	Total	**8**	**462**
071100080403	Cover Crop	18	825

HUC12	Practice Type	Number of Practices	Area of Implemented Practice (acres)
	Riparian Forest Buffer	3	41
	Total	**21**	**865**
071100080404	Cover Crop	28	1,344
	Field Border	1	37
	Grazing System Lime	1	41
	Grazing System Water Distribution	1	19
	Permanent Vegetative Cover - Critical Area	1	2
	Pest Management	3	121
	Sod Waterway	3	61
	Terrace System with Tile	1	13
	Total	**39**	**1,638**
071100080405	Cover Crop	13	1,336
	Sediment Retention, Erosion, or Water Control Structure	1	17
	Sod Waterway	5	253
	Terrace System with Tile	1	7
	Total	**20**	**1,613**
071100080406	Cover Crop	11	667
	Sod Waterway	3	104
	Total	**14**	**771**
071100080407	Cover Crop	5	290
	Well Decommissioning	1	0
	Total	**6**	**290**
071100080408	Cover Crop	13	467
	Total	**13**	**467**
071100080409	Cover Crop	24	810
	Field Border	1	18
	Total	**25**	**828**
071100080410	Cover Crop	19	1,390
	Total	**19**	**1,390**
071100080411	Cover Crop	55	2,658
	Field Border	1	44
	Permanent Vegetative Cover - Critical Area	1	1
	Sediment Retention, Erosion, or Water Control Structure	2	24
	Sod Waterway	13	279
	Terrace System	3	17
	Terrace System with Tile	3	31
	Total	**78**	**3,054**
Grand Total		**1154**	**67,637**

*12-digit HUCs in bold are subwatersheds within the North Fork Cuivre River

6.2 Potential Nonpoint Source Management Measures and Expected Load Reductions

Nonpoint source management measures should focus on reducing *E. coli* where pollutant loading is greatest. These areas are typically considered "critical areas" when developing a 9-element watershed

based plan. Some rural best management practices are described in the following sections. Because land use in the watershed is primarily agricultural, primarily agricultural BMPs are described. However, as noted in the TMDL, suburban areas and urban areas are also present in the watershed and are potential contributes of *E. coli*. For this reason, watershed planning efforts should also consider BMPs to manage stormwater inputs and *E. coli* originating from developed areas. Urban areas where stormwater discharges are regulated through municipal separate storm sewer (MS4) permits are considered point sources and are addressed by the Department's Missouri State Operating Permit Program. Only voluntary measures are included in this implementation strategies document.

6.2.1 Riparian Buffers

Riparian corridor conditions have a strong influence on instream water quality. Wooded riparian buffers are a vital functional component of stream ecosystems and are instrumental in erosion reduction, as well as the detention, removal, and assimilation of pollutants in runoff. Therefore, a stream with good riparian cover is better able to mitigate the impacts of high pollutant loads than a stream with poor or no riparian cover. Shade provided by riparian corridors is also important because it helps to keep water cooler (cold water holds more oxygen) and reduces temperature variation that stresses aquatic life especially during the critical low flows that typically occur in July and August. Riparian buffers have been demonstrated to reduce *E. coli* runoff (Cardoso et al. 2012, Lim et al. 2022). Riparian corridors that lack woody vegetation should be prioritized for riparian restoration.

6.2.2 Streambank Stabilization

Streambank stabilization measures also reduce erosion. Such measures may include the installation of live stakes, coconut fiber rolls and mesh, coir rolls, bank terracing, large woody debris, and large boulders to support streambanks and reduce erosion. Integrating shrub and tree planting with other bank stabilization measures results in long-term stabilization as the vegetative roots expand and provide further soil stability. Many resources are available to guide streambank stabilization design for specific conditions. A good initial reference is the *Army Corps of Engineers Streambank and Shoreline Protection Manual* (https://www.lrc.usace.army.mil/Portals/36/docs/regulatory/pdf/StrmManual.pdf). A study of bank stabilization on the Cedar River in Nebraska found the average streambank erosion rate before stabilization was approximately 1.5 (feet) $ft.^2/ft.$ and was reduced to 0.5 $ft.^2/ft.$ after stabilization measures were implemented (Naisargi and Mittelstet 2017). [7]

6.2.3 Nutrient Management

Nutrient management is an effective strategy for reducing *E. coli* and nutrient loading from agricultural lands to streams, and is may be especially important in the Cuivre River and North Fork Cuivre River due to the amount of land cover classified as pasture/hay in the watersheds. The *Missouri Concentrated Animal Feeding Operation Nutrient Management Technical Standard* is available online at: dnr.mo.gov/document-search/missouri-concentrated-animal-feeding-operation-nutrient-management-technical-standard-march-4-2009. The technical standard describes soil and manure testing protocols, manure application criteria including required setback distances from streams, and monitoring requirements.

The primary goal of nutrient management is to promote biomass productivity that provides profit for producers while minimizing negative environmental impacts. Over-application of nitrogen and phosphorus above the crop needs will cause these nutrients to accumulate in the soil and increase the potential for losses to the environment. Nutrient management planning minimizes the transport of

[7] The Cedar River watershed is located in North Central Nebraska. The western half of the watershed is mainly grassland and sand dunes in the Sand Hills, whereas the eastern half is predominantly cropland.

E. coli, nitrogen, and phosphorus to surface water and groundwater by optimizing manure fertilizer application rates, timing, and placement, as well as accounting for all sources of nutrients.

Nutrient management plan development may be eligible for cost-share through the Soil and Water Conservation Program. Nutrient management plans should be developed in accordance with the Natural Resources Conservation Service (NRCS) Standards and Specifications for Nutrient Management (Code 590). Landowner assistance is available through the local County Soil and Water Conservation Districts.

6.2.4 Cover Crops

Planting cover crops rather than leaving cultivated cropland barren has both economic and environmental benefits. Legume cover crops can reduce fertilizer costs because of their symbiotic relationship with soil bacteria. Specific bacteria reside within the nodules on the roots of legumes such as vetch and clover and convert nitrogen gas from the atmosphere into soil nitrogen that crops can use. This biological nitrogen fixation reduces the amount of fertilizer that needs to be purchased and applied. Applying less manure or fertilizer to the topsoil means reduced transport of *E. coli* or nutrients to water bodies in the watershed. Cover crops also reduce erosion by holding soil in place and reducing top-soil crusting. Reducing runoff is expected to reduce overall contributions of *E. coli* loading from cropland to surface waters. The plant material left behind after cover-cropping increases water infiltration and reduces evaporation. This reduces the amount of nutrient-laden runoff, and the amount of water needed for irrigation. Moisture retention by decaying plant material also helps soils be more resilient to periodic drought conditions.

A study conducted by Zhu et al. (1989) as cited in Sharpley and Smith (1991) found that planting common chickweed, Canada bluegrass, and downy brome on Missouri soybean fields decreased water runoff by an average 44 percent. The study found that nitrogen (as nitrate) loss was reduced by an average 75 percent and soluble phosphorus runoff was reduced by an average 37 percent. Sharpley and Smith (1991) found that planting ryegrass or wheat on peanut crops for 6 months of the year reduced soil loss by an average of 83 percent.

6.2.5 Prairie Strips

Implementing prairie strips in croplands can reduce both soil erosion and nutrient runoff. Prairie strips include edge-of-field filter strips and infield contour buffer strips. Infield contour buffer strips' primary purpose is to reduce erosion, while edge of the field filter strips primary purpose is to filter excess nutrients and animal waste. A study conducted in Iowa found that converting 10 percent of crop field to prairie filter strips reduced average annual nitrate, total nitrogen, and total phosphorous

concentrations by 35, 73, and 82 percent respectively (Zhou et al. 2014). Reductions in erosion are expected to result in reduced *E. coli* loading to surface waters.

6.2.6 Field Borders

Field borders can provide a number of conservation benefits, such as reducing soil erosion from wind and water, protecting soil and water quality and providing habitat for wildlife. These habitats, located at the edges of crop fields, can also serve to connect other buffer practices and habitats within the agricultural landscape. The U.S. Department of Agriculture's Farm Service Agency (FSA) runs a program called the Continuous Sign-up Conservation Reserve Program (CCRP) that provides farmers with rental payments on land set-aside for conservation buffers for a period of 10 to15 years. Cost-share payments are also made available to help farmers with the financial burden of establishing the buffers.

6.2.7 Livestock Exclusion

Livestock that have access to streams increase erosion by reducing streamside vegetation and increasing barren area. Livestock may also contribute *E. coli* and nutrients directly to streams. In addition, compaction from animals contributes to poor quality aquatic habitat because the interstitial spaces in stream substrate are eliminated. Excluding livestock from streams is another way to improve water quality and aquatic habitat in the Cuivre River and North Fork Cuivre River watersheds.

6.2.8 Public Outreach

Public outreach is a key component of any watershed-based plan. Support for nonpoint source reduction plans is generated through education and outreach activities designed to inform the public about water quality issues and what can be done to reduce pollutant loading in watersheds. The following are some activities that may be implemented to develop support and participation for watershed stewardship:

1. Hold meetings and other outreach events to inform private landowners of the available technical support and financial incentives for implementing pollutant reduction strategies.

2. Attend livestock auctions and demonstrations in the local community, and hand-out literature explaining the available technical support and financial incentives for implementing pollutant reduction strategies.
3. Develop small-scale demonstrations of pollutant reduction strategies.
4. Implement a public awareness campaign regarding water quality with public service announcements.
5. Host local watershed festivals.

6.2.9 Onsite Wastewater Treatment System Repair and Maintenance

Failing onsite wastewater treatment systems (e.g., septic systems) may be sources of bacteria to nearby waterways during periods associated with either wet weather or dry weather flows depending upon the nature of the failure. By design, properly functioning onsite wastewater treatment systems should not be contributing significant bacteria or nutrient loads to surface waters. For this reason, the TMDL assigns a load allocation of zero to these potential sources. Proper maintenance of onsite wastewater treatment systems including septic tanks, associated drain fields, and household lagoons is the primary BMP for limiting bacterial inputs from these sources. Educating homeowners about proper onsite wastewater treatment system maintenance may be provided by local health departments, watershed groups, or university extension offices. The EPA maintains various guidance documents and resources pertaining to onsite treatment systems online at https://www.epa.gov/septic. For onsite wastewater treatment systems that are already failing, repair or replacement of the system is necessary. Any local ordinances regarding permitting requirements pertaining to repairs, replacement or the installation of new systems must be followed. Consideration should be given to reducing reliance on onsite systems in favor of centralized systems. Homeowners and local governments should explore the potential elimination of onsite systems and connection to existing sewer systems. Elimination of any onsite wastewater treatment systems in the watershed is expected to result in reductions of bacteria loading.

6.2.10 Stormwater Runoff from Developed Areas

Municipal and suburban areas having substantial amounts of impervious cover (including residential lawns) can contribute contaminated stormwater to surface waters. Green infrastructure and low impact development allows some stormwater to infiltrate into the ground thereby reducing the total amount of runoff entering the stream. Proper disposal of pet waste or manure from "backyard livestock" also reduces bacteria loading to surface waters. EPA maintains resources regarding green infrastructure on its website at https://www.epa.gov/green-infrastructure. EPA maintains a factsheet about reducing the impacts of pet waste at https://cfpub.epa.gov/npstbx/files/pet%20care%20fact%20sheet.pdf. Table D-2 in Appendix D of this implementation strategies document provides a list of commonly used urban BMPs.

7. Measurable Milestones

Measurable milestones outline time frames for the incremental implementation of pollutant reduction strategies. Attainable milestones should be established based on available funding and stakeholder participation. Nonpoint source pollutant reduction plans should include milestones for public outreach, attaining funding, and the implementation of chosen nonpoint source management measures. In addition, monitoring and adaptive management plans should be developed for vegetation restoration areas to ensure that plants are healthy and will grow and develop into effective pollutant attenuation areas. Plans that are developed to procure Section 319 subgrants must be

renewed every five years to stay eligible for funding. It is good general practice to develop measurable watershed management milestones on 5-year timeframes. Riparian buffer restoration monitoring and adaptive management plans should include annual monitoring and assessment of plant growth and development with a 5 to 7 year goal of vegetation maturity. The annual evaluations allow for adaptive management to ensure that efforts are successful. The following is an example of measurable milestones over a 20 year timeframe.

5-Year Milestones

- Conduct outreach, gain public participation, and explore funding options that will allow pollutant reduction strategies to be implemented.
- Develop a comprehensive watershed management plan and identify key areas for implementation.
- Procure funding and begin implementing strategies such that:
    - Nutrient management plans are developed and implemented on 10 percent of unregulated agricultural lands in the watershed, and
    - Riparian buffers, and fencing protects 10 percent of tributaries to the impaired waters.
    - 2 percent of streambanks are stabilized in key areas.
- Complete annual monitoring and adaptive management to assess the effectiveness of streambank stabilization projects and to ensure that all newly established riparian buffers are progressing toward maturity.

10-Year Milestones

- Continued outreach, public participation, and funding procurement.
- Develop and implement nutrient management plans on 25 percent of unregulated agricultural lands in the watershed.
- Construct riparian buffers, and fencing to protect 25 percent of tributaries to the impaired waters.
- Construct streambank stabilization in 5 percent of key areas.
- Complete annual monitoring and adaptive management to assess the effectiveness of streambank stabilization projects and to ensure that all previously established riparian buffers are intact and newly established riparian buffers are progressing toward maturity.

15-Year Milestones

- Continued outreach, public participation, and funding procurement.
- Develop and implement nutrient management plans on 50 percent of unregulated agricultural lands in the watershed.
- Construct riparian buffers, and fencing to protect 50 percent of tributaries to the impaired waters.
- Construct streambank stabilization in 7 percent of key areas.
- Complete annual monitoring and adaptive management to assess the effectiveness of streambank stabilization projects and to ensure that all newly established riparian buffers are effectively attenuating pollutants.

20-Year Milestones

- Continued outreach, public participation, and funding procurement.
- Develop and implement nutrient management plans on 75 percent of unregulated agricultural lands in the watershed.
- Construct bank stabilization, riparian buffers, and fencing to protect 75 percent of tributaries to the impaired waters.

- Construct streambank stabilization in 10 percent of key areas.
- Complete annual monitoring and adaptive management to assess the effectiveness of streambank stabilization projects and to ensure that all previously established riparian buffers are intact and newly established riparian buffers are progressing toward maturity.

8. Cost-Benefit

Cost-benefit analyses may be conducted during the watershed management planning process to determine the most efficient investments of time, effort, and supplies. Costs associated with nutrient management plan implementation and cover crops are relatively minimal because many of the practices are already integrated into the farming system and substantial cost savings are achieved through reducing the need for manure application and chemical fertilizers. Streambank stabilization is the most expensive pollutant reduction strategy but can be limited to key areas to stabilize highly erosive streambanks for the benefit of water quality in all downstream waters.

9. Potential Government Assistance and Funding

Reducing pollutant loading to achieve TMDLs often requires participation and technical support from government agencies. Public service staff can often provide technical guidance and direct interested parties to potential funding sources. Some of the available agencies and organizations and their potential roles, including funding avenues, are listed in Table 9. The list is not exhaustive. The most commonly used sources of funding are the State Revolving Fund, Section 319 subgrants, and cost-share through the Soil and Water Conservation Program.

Table 9. Agency Roles and Funding Options

Agency and Roles	**Funding Options**
US Department of Agriculture, Natural Resources Conservation Service https://www.nrcs.usda.gov/wps/portal/nrcs/site/mo/home/	
Financial assistance and incentives to implement voluntary BMPs.	Environmental Quality Incentives Program (EQIP) Regional Conservation Partnership Program (RCPP) Conservation Stewardship Program (CSP) Agricultural Conservation Easement Program (ACEP)
US Department of Agriculture's Farm Service Agency (FSA) https://www.fsa.usda.gov/	
Administers a program called the Continuous Sign-up Conservation Reserve Program (CCRP) that provides farmers with rental payments on land set-aside for conservation buffers for a period of 10 to15 years. Cost-share payments are also made available to help farmers with the financial burden of establishing the buffers.	Continuous Sign-up Conservation Reserve Program (CCRP)
Missouri Department of Natural Resources https://dnr.mo.gov/	

Agency and Roles	Funding Options
Water Protection Program https://dnr.mo.gov/water/hows-water Implements federal Clean Water Act regulations including: enforcing National Pollutant Discharge Elimination System (NPDES) regulations through point source facility operation permits, establishing Water Quality Standards, identifying impaired water bodies, and developing TMDLs.	Free volunteer water quality monitoring training and tools
Financial Assistance Center dnr.mo.gov/water/business-industry-other-entities/financial-opportunities/financial-assistance-center Provides technical guidance for publicly-owned treatment works and administers low-interest long-term loans to assist with technology and capacity upgrades. The Clean Water State Revolving Fund provides subsidized loans to municipalities, counties, public sewer districts, and political subdivisions for wastewater infrastructure projects. Loans may be paired with grant funds for qualifying communities. Information on the Department's grant policy is available online at dnr.mo.gov/water/business-industry-other-entities/financial-opportunities. Eligible projects include new construction or improvement of existing facilities.	Clean Water State Revolving Fund
Soil and Water Conservation Program dnr.mo.gov/env/swcp/ The Soil and Water Conservation Program (SWCP) provides financial incentives to landowners to implement practices that help prevent soil erosion and protect water quality. The program offers cost-share practices through its county conservation districts. Landowners may receive up to 75 percent reimbursement of the estimated cost of a practice through the program. The primary funding for cost-share practices from the Soil and Water Conservation Program comes from the one-tenth-of-one percent Parks, Soils, and Water Sales Tax.	SWCP cost-share
Section 319 Nonpoint Source Program dnr.mo.gov/water/what-were-doing/nonpoint-source-pollution-section-319 ▪ Provides assistance with the development of watershed management plans and administers Section 319 subgrants for plan development and implementation.	Section 319 subgrants
Missouri Department of Conservation https://mdc.mo.gov/	

Agency and Roles	**Funding Options**
Offers a number of grant and cost-share options including Community Conservation Grant and Land Conservation Partnership Grant mdc.mo.gov/community-conservation/community-conservation-funding-opportunities/. Provides outreach, education, and technical guidance for stream and watershed management issues. Maintains Missouri Conservation lands. Issues permits for fishing and hunting.	Community Conservation Grant and Land Conservation Partnership Grant Free volunteer water quality monitoring training and tools
Missouri Agricultural and Small Business Development Authority agriculture.mo.gov/abd/financial/awloanprg.php	
Offers an Animal Waste Treatment System Loan Program in cooperation with the Clean Water State Revolving Fund. Animal Waste Treatment Loans Program may finance eligible animal waste treatment systems for independent livestock and poultry producers with operations of less than 1,000 animals. Eligible costs include storage structures, land, dedicated equipment, flush systems, composters, and more.	Clean Water State Revolving Fund
University of Missouri Extension https://extension2.missouri.edu/	
Provides guidance for farm management including crop resilience, pond health, and livestock care.	Free information and assistance
County Soil and Water Conservation Districts https://mosoilandwater.land/	
Provides guidance and assistance with the development of nutrient management plans and procurement of funding from the state cost-share program.	Free information and assistance with grant applications
Online Databases of Additional Funding Sources	
▪ Wichita State University, Environmental Finance Center (EFC) Missouri Healthy Watershed Funding Search Tool https://www.wichita.edu/academics/fairmount_college_of_liberal_arts_and_sciences/hugowall/efc/news/meramec-funding-sources-landing-page.php ▪ Catalog of Federal Funding https://www.epa.gov/waterdata/catalog-federal-funding ▪ EPA Nonpoint Source Funding Opportunities http://water.epa.gov/polwaste/nps/funding.cfm ▪ Environmental Justice Grants https://www.epa.gov/environmentaljustice/environmental-justice-grants-and-resources ▪ Grants.gov http://www.grants.gov	

10. Conclusion

The ultimate goal of the Cuivre River and North Fork Cuivre River TMDL is to meet Missouri Water Quality Standards through the protection of whole-body contact recreation. Implementation strategies should follow an adaptive approach that makes progress toward achieving water quality goals while using new data and information to reduce uncertainty and adjust implementation activities. Implementation efforts are expected to occur over a number of years, but within the schedules established in state operating permits and watershed management plans. Success in achieving water quality standards will be determined by the Department through biennial assessments of water quality compliance as required by Sections 305(b) and 303(d) of the federal Clean Water Act.

11. References

Cardoso, F., Shelton, D., Sadeghi, A., Shirmohammadi, A., Pachepsky, Y., & Dulaney, W. (2012). Effectiveness of vegetated filter strips in retention of Escherichia coli and Salmonella from swine manure slurry. *Journal of environmental management*, *110*, 1-7.

EPRI (Electric Power Research Institute). 2000. Advanced On-Site Wastewater Treatment and Management Market Study: Volume 2.

Federal Geographic Data Committee (FGDC). 2003. FGDC Proposal, Version 1.1, Federal Standards for Delineation of Hydrologic Unit Boundaries. December 23, 2003.

Lim, T. J., Sargent, R., Henry, R., Fletcher, T. D., Coleman, R. A., McCarthy, D. T., & Lintern, A. (2022). Riparian buffers: Disrupting the transport of *E. coli* from rural catchments to streams. *Water Research*, *222*, 118897.

MoRAP (Missouri Resource Assessment Partnership). 2005. A gap analysis for riverine ecosystems of Missouri. Final report, submitted to the USGS national gap analysis program. 1675pp.

Naisargi, Dave and Mittelstet, Aaron, R. 2017. Quantifying effectiveness of streambank stabilization practices on Cedar River, Nebraska. *Water* 9:930. doi:10.3390/w9120930.

NRCS (Natural Resources Conservation Service). 2013. Assessment of the Effects of Conservation Practices on Cultivated Cropland in the Arkansas-White-Red Basin. Available URL: https://www.nrcs.usda.gov/publications/ceap-crop-2013-arkansas-summary.pdf [Accessed 16 February 2023]

Sharpley, A.N. and Smith, S.J. 1991. Effects of cover crops on surface water quality. *Surface Water Impacts.* Available URL: http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.596.3210&rep=rep1&type=pdf [Accessed February 2020].

Sutton, Alan L. 1990. Animal Agriculture's Effect on Water Quality Pastures and Feedlots. WQ-7.Purdue University Extension. [Online WWW]. Available URL: https://www.extension.purdue.edu/extmedia/WQ/WQ-7.html [Accessed 16 February 2022]

USEPA (U.S. Environmental Protection Agency). 2006. Establishing TMDL "daily" loads in light of the decision by the U.S. Court of Appeals for the D.C. Circuit in Friends of the Earth, Inc. v. EPA, et al., No. 05-5015, (April 25, 2006), and implications for NPDES Permits. [Online

WWW] Available URL: www.epa.gov/tmdl/impaired-waters-and-tmdls-tmdl-information-and-support-documents [Accessed 14 May 2021].

Zhu, J.C., Gantzer, C.J., Anderson, S.H., Alberts E.E., and Beuselinck, P.R. 1989. Runoff, soil, and dissolved nutrient losses from no-till soybean with winter cover crops. *Soil Science Society of America Journal.* 53:1210-1214.

Appendix A
Nine Key Elements Critical to a Watershed Management Plan

a. An identification of the causes and sources or groups of similar sources that will need to be controlled to achieve the load reductions estimated in this watershed-based plan (and to achieve any other watershed goals identified in the watershed-based plan, as discussed in item (b) immediately below. Sources that need to be controlled should be identified at the significant subcategory level with estimates of the extent to which they are present in the watershed (e.g., X number of dairy cattle feedlots needing upgrading, including a rough estimate of the number of cattle per facility; Y acres of row crops needing improved nutrient management or sediment control; or Z linear miles of eroded streambank needing remediation).
b. An estimate of the load reductions expected for the management measures described under paragraph (c) below (recognizing the natural variability and the difficulty in precisely predicting the performance of management measures over time). Estimates should be provided at the same level as in item (a) above (e.g., the total load reduction expected for dairy cattle feedlots; row crops; or eroded streambanks).
c. A description of the nonpoint source management measures that will need to be implemented to achieve the load reductions estimated under paragraph (b) above (as well as to achieve other watershed goals identified in this watershed-based plan), and an identification (using a map or a description) of the critical areas in which those measures will be needed to implement this plan.
d. An estimate of the amounts of technical and financial assistance needed, associated costs, and/or the sources and authorities that will be relied upon, to implement this plan. As sources of funding, States should consider the use of their Section 319 programs, State Revolving Funds, U.S. Department of Agriculture's Environmental Quality Incentives Program and Conservation Reserve Program, and other relevant Federal, State, local and private funds that may be available to assist in implementing this plan.
e. An information/education component that will be used to enhance public understanding of the project and encourage their early and continued participation in selecting, designing, and implementing the nonpoint source management measures that will be implemented.
f. A schedule for implementing the nonpoint source management measures identified in this plan that is reasonably expeditious.
g. A description of interim, measurable milestones for determining whether nonpoint source management measures or other control actions are being implemented.
h. A set of criteria that can be used to determine whether loading reductions are being achieved over time and substantial progress is being made towards attaining water quality standards and, if not, the criteria for determining whether this watershed-based plan needs to be revised or, if a nonpoint source TMDL has been established, whether the nonpoint source TMDL needs to be revised.
i. A monitoring component to evaluate the effectiveness of the implementation efforts over time, measured against the criteria established under item (h) immediately above.

Appendix B

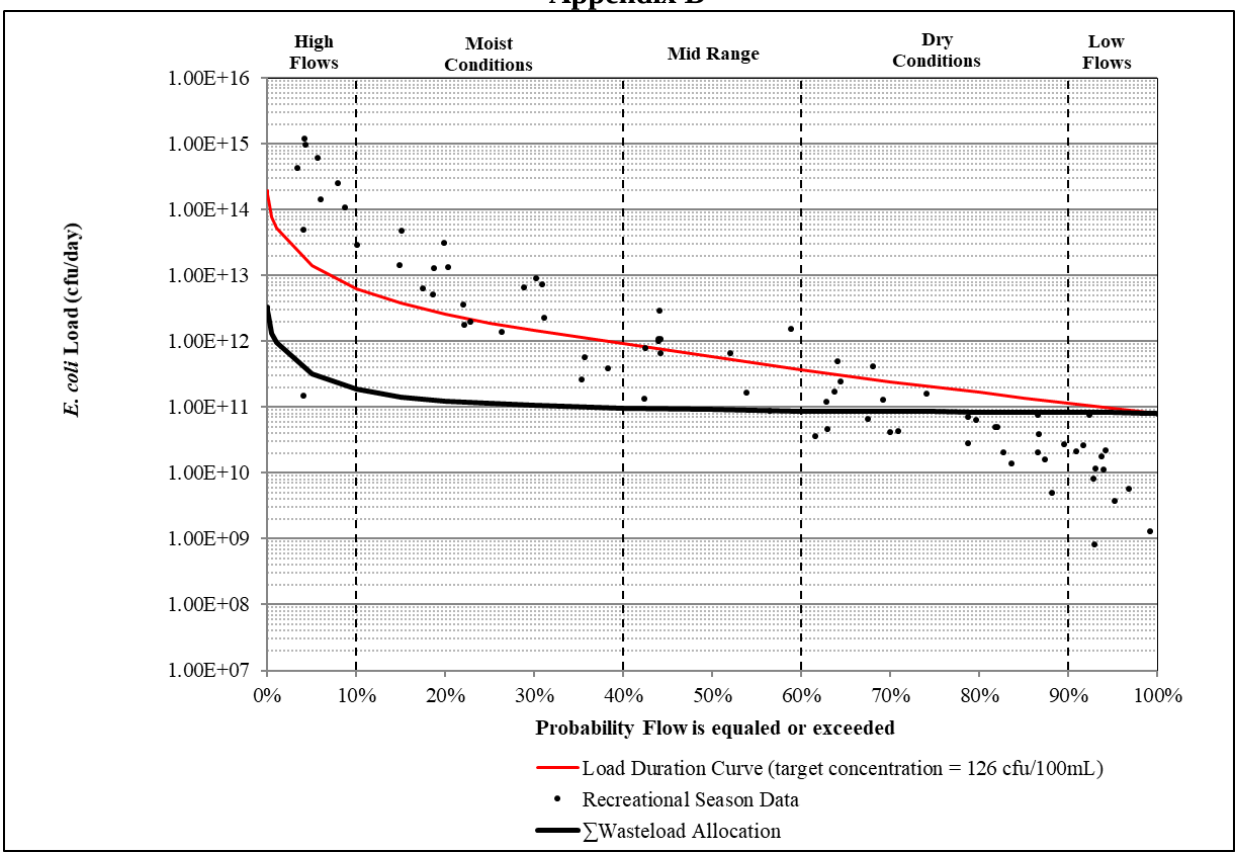

Figure B1. Cuivre River *E. coli* Load Duration Curve

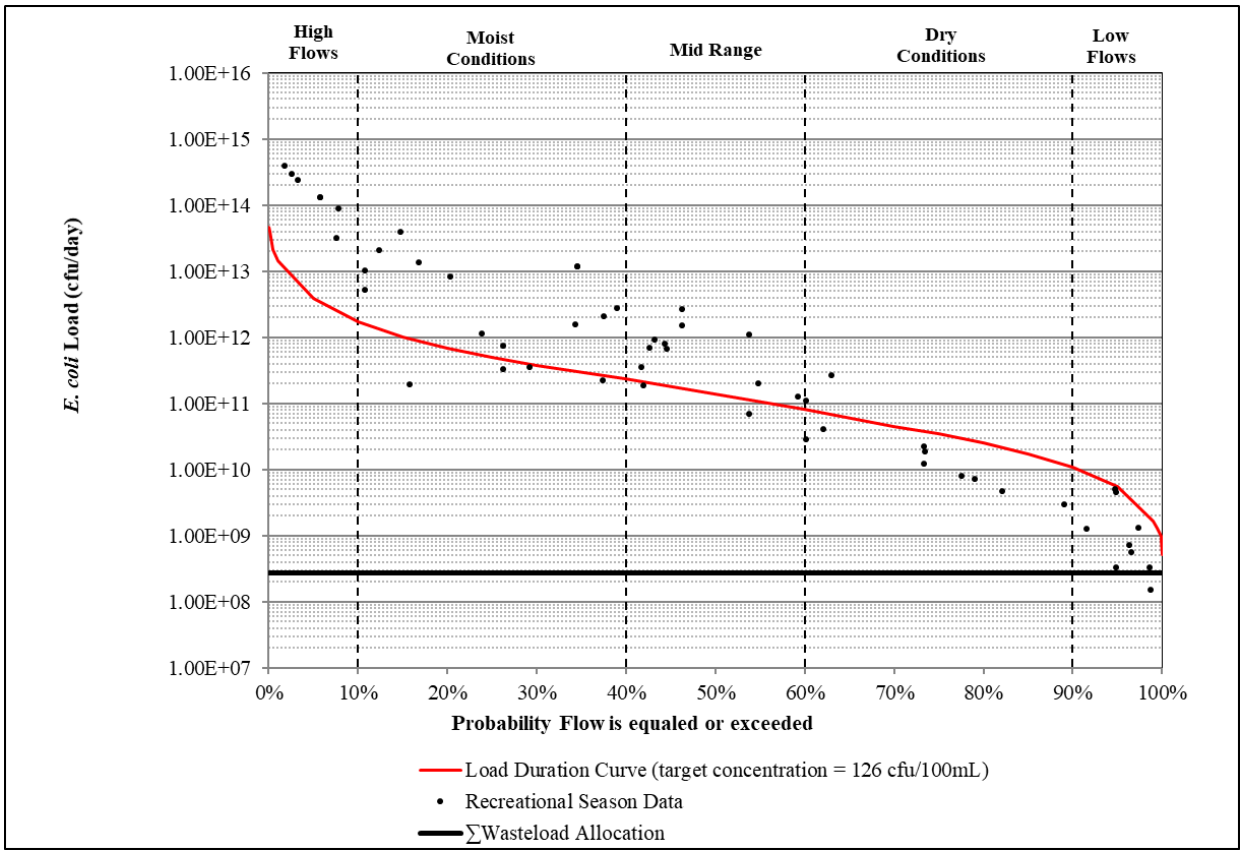

Figure B2. North Fork Cuivre River *E. coli* Load Duration Curve

Appendix C

Water Body	Organization	Site Code	Site Name	Date	Sample ID	*E. coli* (#/100ml)
152	MDNR	152/25.5	Cuivre River near Frenchman Bluff Rd.	9/11/2018	278714	20.1
				10/30/2018	278717	90.9
		152/29.8	Cuivre River at Troy	7/13/2016	267430	178.5
				7/13/2016	267431	161.6
				9/29/2016	267432	31.1
				5/9/2017	272543	115.3
				7/6/2017	272544	4839.2
				8/1/2017	272545	156.5
				8/31/2017	272546	46.4
				8/16/2018	278718	30.1
				8/29/2018	278719	73.8
	USGS			5/19/1999	48577	1000
				7/20/1999	48578	17
				9/8/1999	48579	15
				5/23/2000	48583	2100
				7/11/2000	48584	410
				9/12/2000	48585	66
				5/15/2001	48589	40
				7/24/2001	48590	280
				9/5/2001	48591	320
				5/15/2002	48595	680
				7/10/2002	48596	100
				9/4/2002	48597	50
				5/20/2003	48601	29
				7/22/2003	48602	96
				9/3/2003	48603	1500
				5/3/2004	48607	230
				7/20/2004	48608	200
				9/14/2004	48609	40
				5/3/2005	48614	25

				7/26/2005	48615	22
				9/7/2005	48616	10
				5/16/2006	48620	18
				7/20/2006	48621	17
				4/24/2007	48628	20
				5/21/2007	48629	100
				6/4/2007	48630	480
				7/9/2007	48631	40
				9/5/2007	48632	2
				5/22/2008	48636	64
				7/23/2008	48637	6200
				9/3/2008	48638	680
				5/5/2009	199997	200
				7/29/2009	199998	7100
				9/2/2009	199999	490
				10/29/2009	200000	330
				5/26/2010	200003	100
				7/13/2010	200004	800
				9/8/2010	200005	46
				10/18/2010	200006	22
				5/4/2011	211207	48
				7/11/2011	211208	110
				9/7/2011	211209	1
				10/25/2011	211210	14
				5/2/2012	222499	8500
				7/17/2012	222500	5
				9/5/2012	231545	28
				10/2/2012	237330	8
				5/22/2013	237333	1800

				7/24/2013	237334	65
				9/18/2013	237335	38
				5/14/2014	243623	3800
				7/15/2014	243624	650
				9/3/2014	250493	3200
				10/6/2014	250494	260
				5/5/2015	254782	42
				7/20/2015	254783	1
				9/14/2015	254784	200
				10/20/2015	254785	20
				5/23/2016	277555	180
				7/27/2016	277556	530
				9/12/2016	277557	590
				10/4/2016	277558	23
				5/24/2017	275254	580
				7/18/2017	275255	13
				9/13/2017	275256	24
				10/11/2017	275257	3200
				5/22/2018	276542	480
				7/11/2018	276543	29
				9/11/2018	276544	50
				10/2/2018	276545	14
				5/8/2019	300615	100

				7/24/2019	300616	120
				8/20/2019	300617	68
				9/17/2019	300618	12
				10/2/2019	300619	5
				8/3/2020	301669	210
				10/14/2020	301670	16
158	MDNR	158/4.5	North Fork Cuivre River at Davis Rd.	7/2/2012	227866	17.3
				7/16/2012	227868	7.4
				8/15/2012	229659	21.3
				8/30/2012	229661	9.8
				9/11/2012	232522	101.9
				9/25/2012	232524	51.2
				10/11/2012	232975	17.1
				10/25/2012	232977	33.2
				4/2/2013	233847	25.9
				5/8/2013	234746	410.6
				5/21/2013	234747	4839.2
				6/10/2013	234967	1986.3
				6/24/2013	234969	980.4
				7/1/2013	234971	435.2
				7/15/2013	235381	231
				8/7/2013	235637	61.3
				8/19/2013	235639	27.2

				9/5/2013	236819	30.9
				5/22/2014	242917	206.4
				6/24/2014	242918	1986.3
				7/2/2014	251191	547.5
				8/14/2014	251195	488.4
				9/24/2014	251203	71.2
				10/24/2014	251205	104.6
				10/29/2014	251207	111.2
				4/9/2015	256559	4839.2
				4/20/2015	256561	272.3
				6/1/2015	256568	1732.9
				7/22/2015	256569	816.4
				9/10/2015	256570	1413.6
				4/13/2016	259427	1553.1
				5/12/2016	259428	4839.2
				6/28/2016	267433	579.4
				7/7/2021	310365	203.5
				8/11/2021	310366	172
				9/15/2021	312566	74.3
				10/5/2021	312567	4839.2
				10/19/2021	312568	1986.3
				4/18/2022	354028	4839.2
		158/23.6	North Fork Cuivre River at Kelch Rd	7/8/2021	310363	114.5

				8/12/2021	310364	190.4
				9/20/2021	312563	33.6
				10/4/2021	312564	4839.2
				10/20/2021	312565	1203.3
				4/19/2022	354027	4839.2
		158/7.2	North Fork Cuivre River at Mackville Road	10/10/2013	236821	108.1
				10/30/2013	236822	20.3
				4/22/2014	242922	75.9
				5/6/2014	242924	461.1
				6/9/2014	242925	648.8
		158/11.7	North Fork Cuivre River near Silex	7/7/2021	310361	88.4
				8/11/2021	310362	44.3
				9/15/2021	312560	40.8
				10/5/2021	312561	4839.2
				10/19/2021	312562	1119.9
				4/18/2022	354026	4839.2
177	MDNR	177/2.3	W. Fk. Cuivre R. bl. Hwy. H	7/7/2021	670775	95.9
				8/11/2021	670775	25.6
				9/15/2021	670775	36.8
				10/5/2021	670775	1986.3
				10/19/2021	670775	547.5
				4/18/2022	670775	4839.20
		177/20.4	W. Fk. Cuivre R. @ Beck Rd	7/8/2021	653426	37.9

				8/12/2021	653426	37.3
				10/4/2021	653426	4839.20
				10/20/2021	653426	648.8
				4/19/2022	653426	4839.20
		177/38.2	W. Fk. Cuivre R. @ Campground Rd	7/8/2021	641632	155.3
				7/8/2021	641632	186
				8/11/2021	641632	152.9
				8/12/2021	641632	167
				9/20/2021	641632	55.2
				10/4/2021	641632	4839.20
				10/20/2021	641632	4839.20
				4/19/2022	641632	4839.20

Appendix D

Table D-1. Missouri Soil and Water Conservation Program Cost-Share Practices

Missouri Soil and Water Conservation Program		Practice Mode of Action*			Pollutants Addressed			
Resource Concerns and Associated Cost-Share Practices		Avoid	Control	Trap	Sediment	Nutrients	E. coli	Pesticide
Cost-Share #	Sheet/Rill and Gully Erosion	Sheet/Rill and Gully Erosion						
DSL-01	Permanent Vegetative Cover Establishment	x	x	x	x	x	x	x
DSL-02	Permanent Vegetative Cover Improvement	x	x	x	x	x	x	x
DSL-04	Terrace System		x	x	x	x		x
DSL-44	Terrace System with Tile		x		x	x		
DSL-05	Diversion		x		x	x		x
DSL-11	Permanent Vegetative Cover - Critical Area	x	x	x	x	x		x
DSL-111	Permanent Vegetative Cover - Critical Area: Confined Animal Feedlot	x	x	x	x	x	x	
DSL-15	No-Till System	x	x	x	x	x		x
DWC-01	Water Impoundment Reservoir		x	x	x	x		x
DWP-01	Sediment Retention, Erosion or Water Control Structure		x	x	x	x		x
DWP-03	Sod Waterway	x	x	x	x	x		x
N332	Contour Buffer Strips	x	x	x	x	x		x
N340	Cover Crop	x	x	x	x	x	x	x
N380	Windbreak/Shelterbelt Establishment	x	x	x	x	x		x
N410	Drop Pipe		x	x	x	x		
N585	Contour Stripcropping		x	x	x	x	x	x
Cost-Share #	Grazing Management	Grazing Management						
DSP-02	Permanent Vegetative Cover Enhancement	x	x	x	x	x	x	
DSP 3.1	Grazing System Water Development		x		x	x	x	
DSP 3.2	Grazing System Water Distribution		x		x	x	x	
DSP 3.3	Grazing System Fence	x	x		x	x	x	
DSP 3.3	Grazing System Lime		x			x		
DSP 3.5	Grazing System Seed	x	x	x	x	x	x	
Cost-Share #	Irrigation Management	Irrigation Management						
N430	Irrigation Water Conveyance		x		x	x		x
N442	Irrigation System, Sprinkler	x			x	x		x
N443	Irrigation System, Surface and Subsurface		x		x	x		x
N447	Irrigation System, Tail Water Recovery		x		x	x		x
N554	Drainage Water Management		x	x	x	x		x
N587	Structure for Water Control		x	x	x	x		x
Cost-Share #	Animal Waste Management	Animal Waste Management						
N312	Beef Waste Management System	x	x			x	x	
N312	Dairy Waste Management System	x	x			x	x	
N312	Poultry Waste Management	x	x			x	x	
N312	Swine Waste Management	x	x			x	x	
N316	Incinerator	x	x			x	x	
N317	Composting Facility	x	x			x	x	

Cost-Share #	Nutrient and Pest Management	Nutrient and Pest Management						
N590	Nutrient Management	x	x		x	x	(x)	
N595	Pest Management	x	x					x
Cost-Share #	Sensitive Areas	Sensitive Areas						
C650	Streambank Stabilization		x	x	x	x	x	
DSP-31	Sinkhole Improvement		x	x	x	x	x	x
BDSP-31	Buffer Sinkhole Improvement		x	x	x	x	x	x
N351	Well Decommissioning	x			x	x	x	x
N380	Windbreak/Shelterbelt Establishment	x	x	x	x	x		x
N386	Field Border		x	x	x	x	x	x
N391	Riparian Forest Buffer		x	x	x	x		
N393	Filter Strip		x	x	x	x	x	x
N574	Spring Development	x			x	x	x	
N725	Sinkhole Treatment	x	x	x	x	x	x	x
WQ10	Stream Protection	x	x	x	x	x	x	x
Cost-Share #	Woodland Erosion	Woodland Erosion						
C100	Timber Harvest Plan	x			x	x		
DFR-04	Forest Plantation	x			x	x		
N472	Livestock Exclusion	x			x	x	x	
N655	Restoration of Skid Trails, Logging Roads, Stream Crossings and Log Landings		x	x	x	x		
	Resource Concern and Associated Cost-Share Practices	**Avoid**	**Control**	**Trap**	**Sediment**	**Nutrients**	**E. coli**	**Pesticide**
Note: The above table is meant to provide examples of the most commonly accepted practices employed in Missouri. It is not meant to preclude other practices that that may be appropriate to specific projects or site conditions.		**Practice Mode of Action***			**Pollutants Addressed**			
**Additional information can be found at: https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb1187023.pdf*								
(x) count if management plan is for animal waste								

Table D-2. Commonly Used Land Management Practices in Urban Environments

Common Land Management Practices	Practice Mode of Action			Pollutants Addressed			
	Avoid	Control	Trap	Sediment	Nutrients	E. coli	Pesticide
Urban	**Urban**						
Bioswale		x	x	x	x	x	
Detention basin		x	x	x	x	x	
Fertilizer management	x	x			x		
Enhanced infiltration (soil amendment)	x	x	x	x	x		
Irrigation management	x	x			x	x	x
Low impact landscaping	x			x	x		x
Pest management							x
Porous pavement		x	x		x	x	x
Rain garden		x	x	x	x	x	x
Rain water harvesting	x	x		x	x	x	
Other	**Other**						
Alum application		x	x		x		
Filter/buffer strip		x	x	x	x	x	x
Grade stabilization structure		x		x			
Grass seeding	x	x		x	x		
Habitat improvement	x	x		x	x	x	
On-site wastewater system upgrade		x			x	x	
Riparian restoration	x	x	x	x	x	x	x
Sediment control basin		x	x	x	x	x	
Sediment removal		x		x	x		
Shoreline stabilization		x		x	x		
Stream bank stabilization		x		x	x	x	
Water diversion	x	x		x	x		
Water retention basin		x	x	x	x	x	x
Well decommissioning	x				x	x	x
Wetland Restoration/Construction		x	x	x	x	x	x
Practice Facilitation	**Practice Facilitation**						
Conservation consultant							
Crop production deferment	x	x		x	x		x
Common Practices	**Avoid**	**Control**	**Trap**	**Sediment**	**Nutrients**	**E. coli**	**Pesticide**
	Practice Mode of Action			**Pollutants Addressed**			

Appendix E
Nutrients

This information is provided for informational purposes only

Nitrogen and Phosphorus

Missouri's water quality standards do not establish nutrient criteria for streams. However, nutrient load reductions are a statewide priority, and many of the nonpoint source management measures that reduce *E. coli* loading also reduce nitrogen and phosphorus loading. Excessive nitrogen and phosphorus loading can contributes to excessive algae growth causing low oxygen levels in surface water that impairs aquatic life and contributes to bad tasting drinking water (NRCS 2013).

Nutrient targets are based on RTAG benchmark values. These benchmark values are expected to be protective of Missouri's designated uses, but are not water quality criteria codified in Missouri's Water Quality Standards regulations at 10 CSR 20-7.031. In the absence of Missouri specific nutrient criteria for streams, these targets are provided only as guidance to assist watershed planning activities. Cuivre River and North Fork Cuivre River are not currently identified as impaired due to nutrients and no specific nutrient reduction is required for attainment of existing applicable water quality standards. Groups developing their own watershed plans may determine that alternative, scientifically defensible, nutrient targets are more appropriate. If a TMDL is developed in the future to address nutrient pollution in Cuivre River and North Fork Cuivre River, then the load allocations established in that approved TMDL should serve as the targets for watershed planning and nonpoint source nutrient reduction efforts.

Tables E1 to E4 summarize the nitrogen and phosphorous loads in the Cuivre River and North Fork Cuivre River watershed at selected flows. The load reductions were calculated based on the 95^{th} percentile of observed total nitrogen and total phosphorous that exceeded the RTAG recommendation of 0.9 milligram per liter (mg/L) of total nitrogen and 0.075 mg/L total phosphorous. The data were collected by the Department from 2013-2021.

Table E1. Total Phosphorous Loads and Reductions in the Cuivre River

Time Flow is Exceeded	Flow Condition	Flow (cfs)	Target Load (lbs/day)	Existing Load (lbs/day)	Need Reduction (lbs/day)	Needed Reduction (%)	Existing Concentration (mg/L)
0.95	Low flow	23	9	10	1	8%	0.081
0.75	Dry conditions	57	23	59	36	61%	0.190
0.50	Mid Range	182	73	239	165	69%	0.244
0.25	Moist Conditions	608	246	4,362	4,116	94%	1.330
0.05	High Flow	4,664	1,887	130,316	128,429	99%	5.180

Table E2. Total Nitrogen Loads and Reductions in the Cuivre River

Time Flow is Exceeded	Flow Condition	Flow (cfs)	Target Load (lbs/day)	Existing Load (lbs/day)	Need Reduction (lbs/day)	Needed Reduction (%)	Existing Concentration (mg/L)
0.95	Low flow	23	110	97	0	0%	0.79
0.75	Dry Conditions	57	279	889	610	69%	2.87
0.50	Mid Range	182	882	3,242	2,360	73%	3.31
0.25	Moist Conditions	608	2,953	22,333	19,380	87%	6.81
0.05	High Flow	4,664	22,643	506,036	483,393	96%	20.11

Table E3. Total Nitrogen Loads and Reductions in the North Fork Cuivre River

Time Flow is Exceeded	Flow Condition	Flow (cfs)	Target Load (lbs/day)	Existing Load (lbs/day)	Need Reduction (lbs/day)	Needed Reduction (%)	Existing Concentration (mg/L)
0.95	Low Flow	0.79	4	no data	no data	no data	no data
0.75	Dry Conditions	5.04	24	16	0	0.00%	0.58
0.50	Mid Range	18.60	90	no data	no data	no data	no data
0.25	Moist Conditions	60.56	294	1,144	850.21	74.31%	3.50
0.05	High Flow	525.81	2,553	no data	no data	no data	no data

Table E4. Total Phosphorus Loads and Reductions in the North Fork Cuivre River

Time Flow is Exceeded	Flow Condition	Flow (cfs)	Target Load (lbs/day)	Existing Load (lbs/day)	Need Reduction (lbs/day)	Needed Reduction (%)	Existing Concentration (mg/L)
0.95	Low Flow	0.79	0.32	no data	no data	no data	no data
0.75	Dry Conditions	5.04	0.59	4.03	3.43	85.24%	0.15
0.5	Mid Range	18.60	0.96	no data	no data	no data	no data
0.25	Moist Conditions	60.56	1.44	229.73	228.29	99%	0.70
0.05	High Flow	525.81	2.04	no data	no data	no data	no data